

# Act 250 at 50: Obstacles and Opportunities for the Future

Spencer Ainsworth  
Isabel Herrick  
Hollis Rhodes

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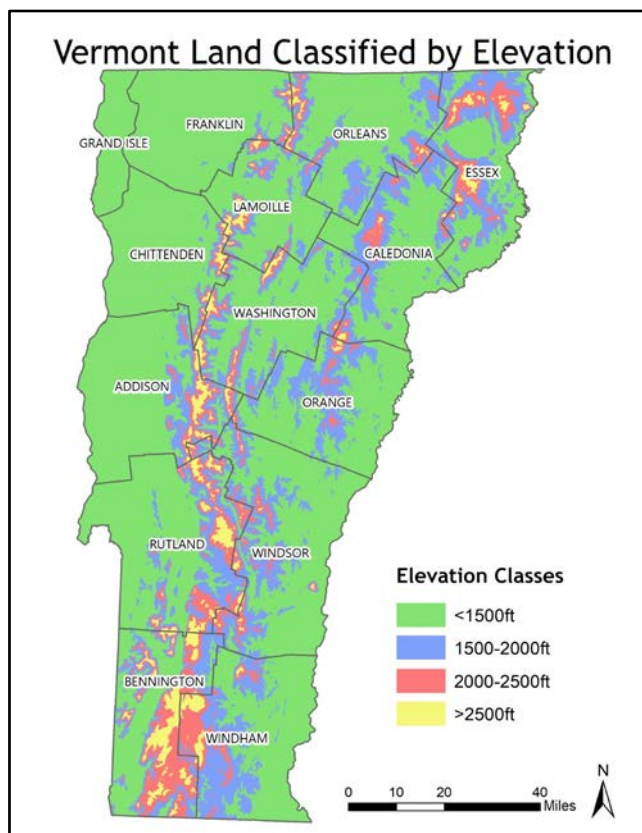
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## I. Executive Summary

### Abstract:

*Act 250 is a comprehensive environmental review process whereby all developments over certain jurisdictional thresholds are required to go through a permitting process to assess their impact on the environment and the surrounding community. Act 250 was originally passed in 1970 in response to concerns about overdevelopment in the state resulting from population growth. The original vision of the bill was to support compact village centers surrounded by a working agricultural landscape with an emphasis on conserving blocks of intact forests with high levels of connectivity. Unfortunately, Vermont's development patterns have strayed from this vision. A slow erosion of the act's jurisdictional power over the last fifty years and the need to address new environmental challenges necessitate the passage of a new bill to update Act 250 and prepare Vermont for the future. As part of this process, we worked with Representatives Amy Sheldon and Trevor Squirrell, and were charged with performing GIS analysis related to the proposed lowering of the elevation threshold for which Act 250 jurisdiction would apply, as well as proposing recommendations regarding environmental justice, climate change, and forest fragmentation. With the GIS analysis and four recommendations detailed below we hope to actualize the function of Act 250 in support of a more hopeful and just future that conserves Vermont's unique ecosystem for all to enjoy.*

### GIS Analysis:



Considering the legislature's emphasis on using Act 250 as a land use regulation capable of shaping Vermont's landscape, it is important to consider the spatial effects of the new bill. To that end, a GIS analysis was conducted to assess 1) how much land could potentially fall under Act 250 jurisdiction by lowering the elevation threshold from 2500 ft to 2000 or even 1500 ft and 2) how many parcels have previously had a development which went through the Act 250 process. Some regions of Vermont, notably the northwest and the Champlain Valley, have no land above 2000 ft so the lowering of the elevation threshold would have no effect on them. Others, such as the southwestern portion of the state and the Northeast Kingdom have extensive areas of land above that elevation. Specifically, 25% of the land in Bennington County and 15% of the land in Essex County is between 2000 and 2500 ft. Furthermore, it is important to acknowledge that much of the high elevation land in southwest VT is federal national forest land whereas the high elevation land in the Northeast Kingdom is privately owned, typically by timber companies. Therefore, it is more likely that this high elevation land will end up being sold and developed, placing it under the jurisdiction of Act 250. Lowering the threshold to 1500 ft would affect the state more evenly. All but three counties contain between 13 and 33% land between 1500 and 2000 ft.

Another conclusion from the GIS analysis is that the current format of Act 250 data limit the extent of spatial analysis. Act 250 permits are recorded as point data which can be deceptive because points cannot represent the acreage actually covered by the Act 250 permit. Some developments, such as a new trailhead in the Green Mountain National Forest, are best represented by a point whereas other developments span an entire parcel and would be better represented by a polygon. A complete map showing the total acreage of land covered by Act 250

cannot be created without more specific data. We recommend that all future Act 250 permits require applicants to include a polygon shapefile of the proposed development

### **Recommendations:**

1. *Remove forestry, farming, and power exemptions on development and subdivision that occurs on a parcel of forestland greater than or equal to 1,500 acres in size.*

The intention behind this recommendation is to change the jurisdictional trigger for the subdivision of parcels in ecologically valuable forest blocks and development in the most critical areas for forest integrity, a method which the Vermont Department of Forests, Parks and Recreation and the Agency of Natural Resources promoted in their Vermont Forest Fragmentation Report in 2015. This would allow Act 250 to review projects with the most potential to disrupt critical resource areas while minimizing regulation for smaller forest blocks and large non-forested parcels (Vermont Department of Forests, Parks and Recreation 2015). The Department of Fish and Wildlife identified the best examples of habitat blocks to be 500 to 1,000 acres or larger (Sorenson & Osborne 2011). The Department of Forests, Parks and Recreation as well as the Agency of Natural Resources and the Fish and Wildlife Department, determine large forest blocks to be the most important because they provide recolonization space for species displaced by climate change and other environmental stressors. Given that there are 66 private or municipal parcels greater than or equal to 1,500 acres in Vermont, we consider this a good size threshold for protecting forest blocks (Keeton et al., 2018).

2. *When any development or subdivision occurs on parcels of 450 acres or greater, regardless of exemptions, that property must undergo an assessment to be part of the carbon market. For details see report section on Vermont Forest Carbon Sequestration Working Group (p.16).*

One issue landowners face when considering generating carbon offsets is balancing the cost of assessment with the price of carbon credits. As a result, it has historically only made sense for landowners with several thousand acres to enter the carbon market. The intention behind a 450-acre threshold is that the Vermont Forest Carbon Sequestration Working would recommend a process for the state to aggregate adjoining parcels to achieve economies of scale. Properties below 450 acres are not currently feasible for forest carbon projects due to financially viable aggregation projects totaling 5,000 acres, and the need for individual parcels to be a minimum number of acres so that credits can be generated (Keeton et al. 2018).

The Vermont Department of Forests, Parks, and Recreation encourages monetizing ecosystem services as a method to promote forest integrity. Through this recommendation, Act 250 would provide information disclosure for the state and assist in streamlining the forest carbon offset issuance process for Vermont forest landowners. Furthermore, this recommendation would also address forest fragmentation and climate change.

3. *We recommend an additional criterion be added that requires developers to demonstrate they will not violate the Environmental Protection Agency's definition of environmental justice. This criterion will require a community participation process through public hearings if any concerns are raised with regards to environmental injustice.*

By restricting marginalized, low-income, and minority populations from having a voice in the decision-making process regarding the environmental consequences of developments in their communities, state law can perpetuate environmental injustice in Vermont. While Criterion 8 of Act 250 requires developers to consider cultural and historical implications of site placement, there is no specific language regarding environmental justice in the act (Draft of Bill to Act 250 2019). We recommend that the committee add a new criterion that includes the definition of environmental justice: “the fair treatment and

meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (EPA 2013).

Under this new criterion, all projects seeking an Act 250 permit would have to demonstrate that they will not violate this criterion. If concerns are raised regarding any project not meeting the environmental justice standards, the developers, in conjunction with the district commission, would need to hold public hearings to allow community members to have an active voice in the development and decision-making process. Under this criterion’s definition of environmental justice, fair treatment occurs when “no group of people ... bear a disproportionate burden of environmental harms and risks, including those resulting from the negative environmental consequences of industrial, governmental, and commercial operations or programs and policies” (EPA 2013). The EPA outlines four requirements for the meaningful involvement of all people: “(1) potentially affected community members have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public’s contribution can influence the regulatory agency’s decision; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected” (EPA 2013).

4. *To combat the imminent threat of climate change to Vermont ecosystems, we recommend that Act 250 include a new criterion that requires specific green building standards.*

Act 250 requires developers to consider sustainable and regenerative building practices, however there is no specific requirement for renewable energy infrastructure on the proposed building site. Several different sustainable building frameworks are marketed

to developers, the most prominent being LEED certification. While it is not practical for Act 250 to require LEED certification on all projects seeking a permit, aspects of this certification should be incorporated into an Act 250 criterion. Specifically, Act 250 should expand sustainable building standards by requiring that all buildings include renewable energy sources on site, if possible. Additionally, all developers must include plans for how the development could achieve or transition to zero net energy (ZNE), a system in which all buildings produce as much energy as they consume over the course of a year from renewable energy sources on site. Developers applying for an Act 250 permit should also consider seeking ZNE on a community or campus scale so that multiple renewable energy sources can power larger developments.

This recommendation draws inspiration from California's goal to have all new residential and commercial buildings reach ZNE by 2030 (California Public Utilities Commission 2019). While this goal is ambitious to implement on a state-wide scale, the presence of climate change and renewable energy legislation in Vermont and California will aid the expansion of ZNE requirements. Act 250 can utilize California's framework for adopting a statewide ZNE system that will minimize Vermont's reliance on carbon-intense energy sources.



## II. Context for Policy Recommendations and GIS Analysis

As students of Middlebury College's Environmental Studies Community-Engaged Practicum, we partnered with representatives Amy Sheldon and Trevor Squirrel to provide recommendations for Act 250's new draft bill. As Act 250 celebrates its 50th Anniversary in 2020, Vermont legislators have been tasked with updating the statute to address lowering the elevation threshold as well as climate change, forest fragmentation and environmental justice - issues not covered by the original statute. We have performed GIS analyses regarding lowering the elevation threshold, have extensively researched case studies on land use regulation from the local to international level concerning the three issues listed above, and have provided four recommendations so that Act 250 can better address them. This section is an elaboration on these recommendations, previously introduced in the executive summary.

### GIS Analysis:

The original goal of the GIS analysis was to assess the impact of lowering the Act 250 elevation threshold based on the topography of Vermont and the pre-existing spatial distribution of Act 250 permits. Analyzing the topography of Vermont was a straightforward process of reclassifying a digital elevation model to reflect elevation thresholds and then calculating the distribution of each class across different spatial scales (see Appendix for methodology). The resulting map, Figure 1, shows that at the county scale the land between 1500 and 2000 ft is more equally distributed than the land between 2000 and 2500 ft. Assessing the spatial distribution of Act 250 permits is far more difficult. Currently, Act 250 permits are only recorded as point data even though the permits are associated with parcels. The permit point data can be

merged with a parcel map by selecting all parcels intersected by Act 250 points, but doing so fails to reflect the true extent of land covered by Act 250 permits for two reasons.

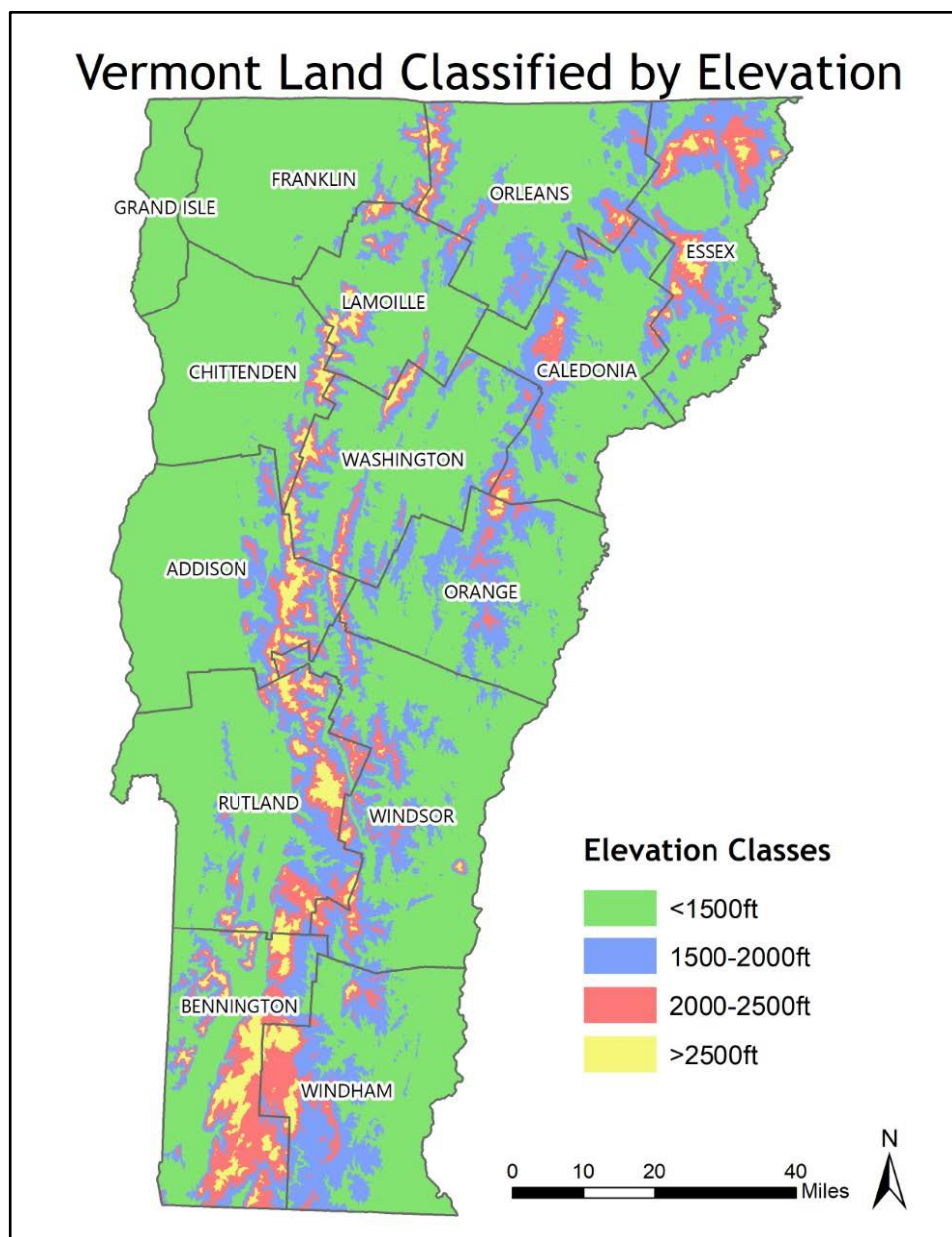
First, an Act 250 permit often does not cover an entire parcel. For instance, the Green Mountain National Forest contains some of the largest parcels in the state and one Act 250 permit within its boundaries is for the construction of a new trailhead. In that case, classifying the entire parcel as under Act 250 would overcount the actual area covered by the permit by several thousand acres. Therefore, the 14% of the total state land area calculated as under Act 250 permits (Figure 2) represents an upper bound on the actual amount of land covered. Because more detailed polygon shapefiles are not available for permits, the actual number cannot be calculated.

The second problem with representing Act 250 permits with point data is that inaccuracy is inevitable. The points are often located on the margins of parcels near roads and sometimes those points are erroneously placed outside of the property parcel and within the road parcel. This problem is illustrated by Figures 3 and 4 which show all of the Act 250 permits within a section of Burlington. It appears that every road is covered by an Act 250 permit but that is an error. All of the roads in this area are represented by a single polygon and this polygon is mistakenly intersected by a point circled in yellow in Figure 4. Based on the description associated with the point, it was intended to be placed on the adjacent parcel, but as a result of the mistake, all of the roads in the area were highlighted.

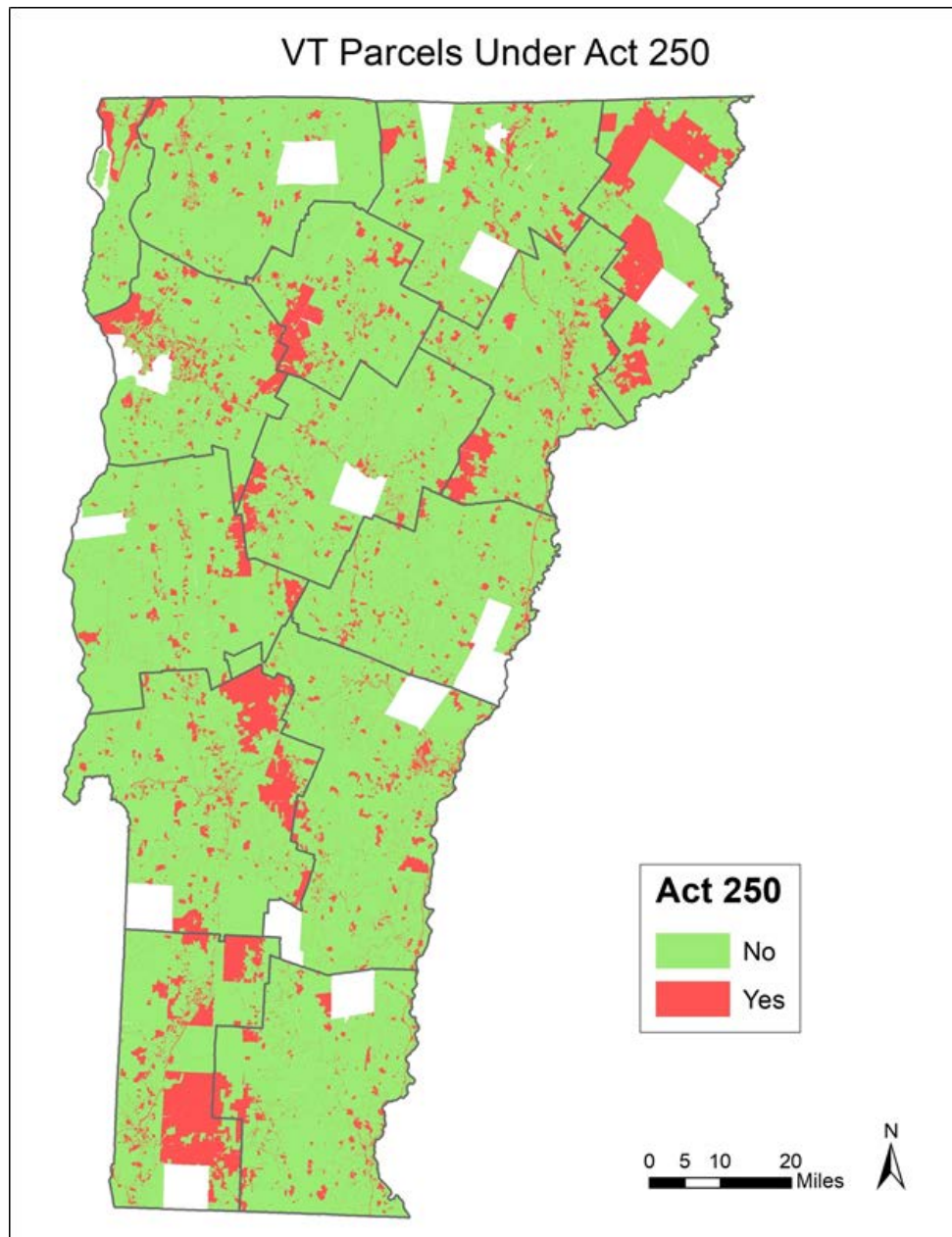
The current status of Act 250 permit data prevents meaningful analysis of current statewide Act 250 coverage from being conducted. In order for state regulatory agencies to better understand the status of Act 250 permits and land-use regulation across the state, **we recommend that all future Act 250 permits require applicants to include a polygon**

**shapefile of the proposed development.** To address the status of the thousands of permits which currently only exist as point data, we propose converting them to polygons by georeferencing the site plans included in the applications though this may be too daunting a project to undertake.

As a result of the limitations of the data mentioned above, the other maps and table which had been previously drafted were omitted from this section but are included in the appendix, along with a detailed explanation of the workflow used to generate each figure.



*Figure 1. Vermont Land Classified by Elevation. Data from VCGI.*

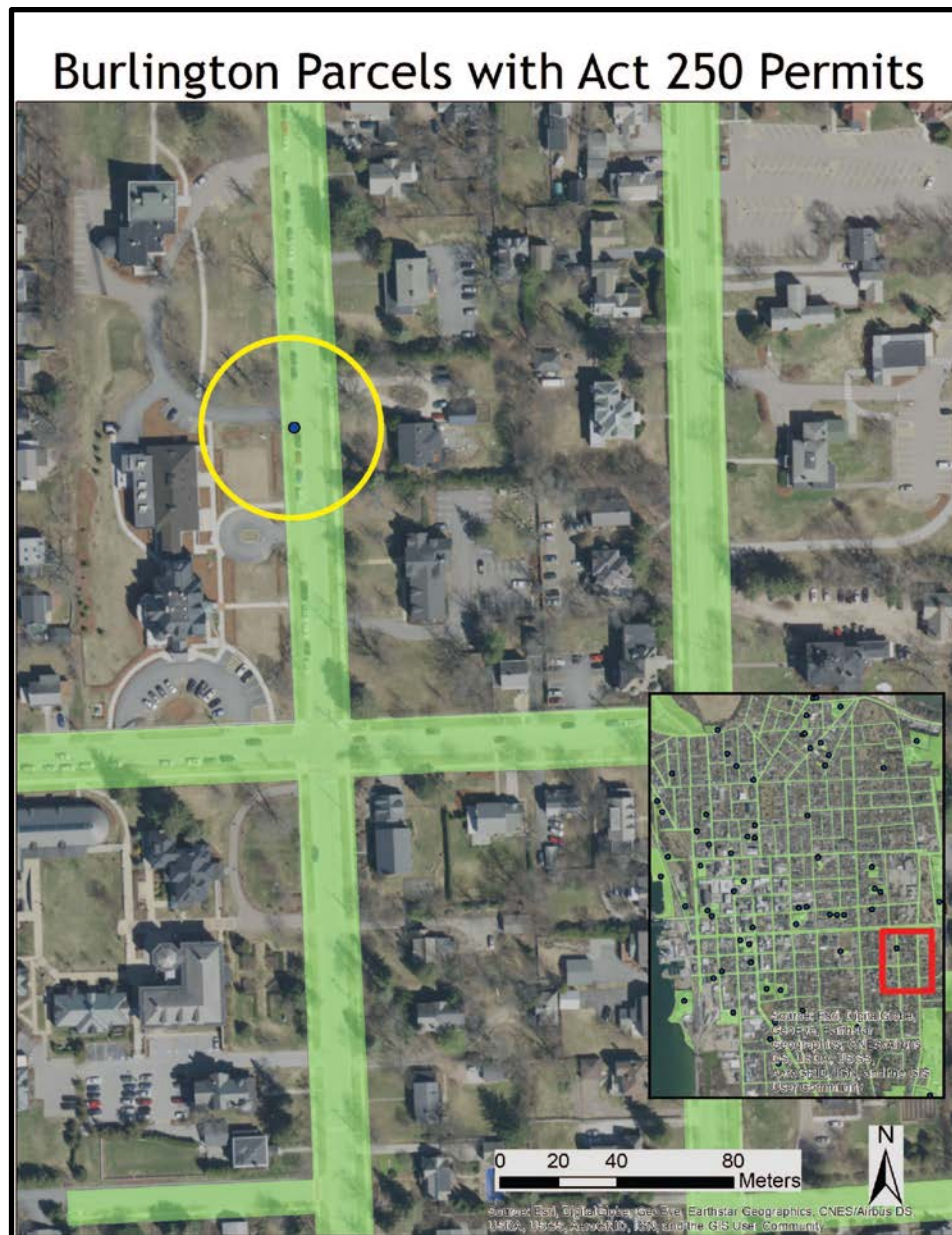


*Figure 2. Vermont parcels under Act 250. Note that this map shows parcels with an Act 250 permit but does not represent the total acreage covered by Act 250. Also note that this map was made in November 2019 while the VCGI was in the process of digitizing parcels for every town which explains the missing data. As of 12/11/2019, the parcel data for all but one town is available. Data from VCGI.*



*Figure 3. Burlington parcels with Act 250 permits. All parcels highlighted in green are intersected by Act 250 permits. Data from VCGI.*





*Figure 4. A subset of Figure 3 demonstrating the potential for inaccuracy with using point data. The red rectangle in the inset map shows the extent of Fig. 4 within the context of Fig. 3. The point in question is circled in yellow. Data from VCGI.*

*Recommendation 1: Remove forestry, farming, and power exemptions on development and subdivision that occur on parcels of forestland greater than or equal to 1,500 acres in size.*

The Vermont Department of Forests, Parks and Recreation conducted a forest fragmentation report, which drew attention to 80% of Vermont forestland being privately owned, and the fact that the demographic of these landowners is changing. The forest landowners are getting older, precipitating a change in ownership to a younger generation, which the Agency of Natural Resources considers a risk to increasing levels of forest fragmentation. The new draft bill to Act 250 intends to repeal the farming, logging, and forestry exemptions when those activities occur in critical resource areas. This draft bill also includes sufficient definitions of forest block, fragmentation, connecting habitat, and other important and relevant terms. Therefore, when a development goes through the Act 250 review process, the statute - especially when the current draft bill to Act 250 reinforces it with additional protection measures for forest fragmentation - has the ability to conserve forest blocks and critical areas. This recommendation lowers the jurisdictional threshold so that any development or subdivision on 1,500 acres of forestland or greater must go through Act 250, which ensures more large forest blocks go through the Act 250 process, thereby increasing the chances that the most important forest blocks, interior forest habitats, and critical resource areas are protected.

*Recommendation 2: When any development or subdivision occurs on parcels of 450 acres or greater, regardless of exemptions, that property must undergo an assessment to be part of the carbon market. For details see below section, Vermont Forest Carbon Sequestration Working Group.*

#### Forest Carbon Offsets Addressing Climate Change

To address climate change, Vermont is committed to reducing 80 to 95 percent of greenhouse gas emissions below 1990 levels by 2050. Climate change is a complicated problem that requires a multi-pronged approach. The Nature Conservancy (TNC) promotes avoided



deforestation and reforestation as cost-effective and successful ways to reduce greenhouse gas emissions (TNC 2018). U.S. forests currently offset between 10 to 20% of U.S. emissions each year (Patch 2019). TNC believes that avoided deforestation and reforestation could reduce greenhouse gas emissions by one third of the amount required by 2030 to keep global warming below 2°C (TNC 2018). They also find it important that, “as carbon markets continue to grow, payments for carbon offsets could offer income for landowners who adopt climate-friendly management strategies” (TNC 2018). With a warming climate, protecting Vermont forests will be increasingly important because Vermont is in a transition area and as a result the state is expected to witness significant climate in-migration. An important step to prepare forests for the future is to protect wildlife corridors and critical habitat areas, and to promote forest blocks, which cannot exist if the forest is fragmented.

#### Role of Vermont Forest Carbon Sequestration Working Group

The Vermont Forest Carbon Sequestration Working Group is a group within the legislature that is putting together a report regarding facilitating forest carbon offset issuance for interested landowners. By the end of their term in January 2020, they will determine which respective departments in the executive branch will undertake a Vermont carbon offset program. The group’s final conclusions will determine whom Act 250 will inform of forestland properties 450 acres or greater. Thus far, the group is planning to recommend that:

1. The Department of Forests, Parks and Recreation develop a public information resource regarding forest carbon sequestration programs.
2. The Agency of Natural Resources evaluate the feasibility of enrolling municipal and state forestland into a forest carbon sequestration program.

(Montpelier (Vermont) State House, Minutes of Meetings of the Vermont Forest Carbon Sequestration Working Group, Meeting of 19 November 2019).

The success of this recommendation is largely dependent on the Vermont Forest Carbon Sequestration Working Group's ability to institute a carbon aggregation project or process at the state level by the end of their term. With this recommendation, any development or subdivision on forestland properties of 450 acres or more will undergo an assessment to be part of the carbon market. Act 250's role in this would be to inform the appropriate state carbon sequestration entity of the offset potential of any 450 acre or greater forestland property once they trigger Act 250 with this new criterion.

Our interview with Billy Coster, the Agency of Natural Resources' director of planning, referred us to the Cold Hollow to Canada (CHC) Aggregation Project, Vermont Forest Carbon Report, and the Vermont Forest Carbon Sequestration Working Group. He informed us that the Vermont government was exerting much effort to study the potential of compensating landowners for sequestering carbon. According to Coster, there is much interest in monetizing ecosystem services, and carbon offsets are great because they balance efforts to conserve forest resources while also supporting struggling landowners.

#### The Vermont Forest Carbon Report - 450 Acre Reasoning

The Vermont Forest Carbon Report was conducted and advised by organizations such as the Spatial Informatics Group, University of Vermont, Nature Conservancy, and Vermont Land Trust. The purpose of the report is to determine the best way for as many Vermont forest landowners as possible to access the carbon markets, so that forestland can be conserved while providing woodlot owners with an additional revenue stream. The intention behind a 450-acre

threshold is due to the Vermont Forest Carbon Report conclusion that properties below this threshold are not currently feasible for forest carbon projects due to high administrative costs.

Project aggregation allows for forest owners with insufficient forestland to generate carbon offsets and attain an additional revenue stream. This is especially relevant for Vermont, considering that privately owned forestland has, on average, a low parcel size. In order to be cost efficient, it is recommended that projects aggregate to achieve 5,000 acres in size. If the parcels are all on the order of 450 acres, this would mean that at least ten adjoining parcels must be aggregated. There is a potential for properties of a smaller size to be aggregated, which the Vermont Forest Carbon Report considers to be a minimum of 200 acres. However, this would significantly increase the number of adjoining parcels that must be aggregated to attain a total project size of 5,000 acres. In addition, there would need to be some larger parcels, of at least 500 acres in size, to anchor a project. The report concluded that forest carbon projects are not currently feasible on properties lower than several hundred acres in size: “a forest carbon project is simply not viable without a minimum number of acres over which credits can be generated from both baseline reductions and annual growth” (Keeton et al. 2019, 35). The CHC project also used 450 acres as the threshold when aggregating properties.

The Vermont Forest Carbon Report found that there are 328,461 acres of privately-owned parcels greater than 500 acres in size and that have at least 450 acres of forest each. Of these, roughly 285,000 acres are within or adjacent to priority forest blocks and are highly ranked for flood resilience benefits (Keeton et al. 2019).

#### Act 250 Information Disclosure for Offset Potential

The Toxic Release Inventory (TRI) is a federal program which tracks the management of toxic chemicals. Facilities in different industry sectors must annually report the release and

management of chemicals across their life cycle. The information which facilities submit is compiled into the Toxics Release Inventory and allows for companies, the public, and government to make informed decisions (EPA 2019).

Similar to the TRI, with this recommendation, Act 250 would disclose information to the state regarding the potential for parcels to be aggregated and assist in streamlining the forest carbon offset issuance process for Vermont forest landowners.

#### Cold Hollow to Canada Forest Carbon Aggregation Project

The Cold Hollow to Canada Forest Carbon Aggregation Project in the Cold Hollow Mountains in Northern Vermont aggregates forestland with at least 450 acres and helps landowners access the carbon market. The program performs a climate change analysis for woodlot owners' forest management plans, which informs landowners of how much carbon they are currently sequestering and the potential for them to sequester more. CHC then works with UVM and the Vermont Land Trust to sell carbon credits at a Vermont scale on the voluntary market. The mission of CHC is to aggregate smaller forest parcels to create a large enough area to sell on the carbon market. Historically, it was only financially viable for landowners with several thousand acres to enter the carbon market (to balance the cost of assessment with the price of the carbon credits). The CHC project makes Vermont forest landowners eligible for the carbon market who otherwise would not have been. The preliminary value of a credit in the CHC aggregation model is approximately \$15.00 per acre per year over a ten-year period (Patch 2019).

#### Limitations

Aggregated carbon projects are mostly limited to the voluntary markets, because the main compliance carbon market - California Air Resource Board's (CARB) cap-and-trade program -

does not allow project aggregation. Three central voluntary carbon market standards in North America are the Climate Action Reserve (CAR), American Carbon Registry (ACR) and the Verified Carbon Standards (VCS), which all permit project aggregation. The CHC project sold carbon credits on the voluntary market, but did not disclose through which registry (Patch 2019). The Nature Conservancy's Burnt Mountain project is a recent 5,500-acre acquisition on which they placed a "forever wild" easement to help create an 11,000 acre block of unfragmented forest that will be protected in perpetuity (The Nature Conservancy 2019). The project is not financially feasible for the California carbon market and will also be entering the voluntary market (Vermont Forest Carbon Sequestration Working Group 2019).

Most importantly, the success of this recommendation is largely dependent on the Vermont Forest Carbon Sequestration Working Group's ability to instate a carbon aggregation project or process at the state level by the time they submit their report in January.

*Recommendation 3: We recommend an additional criterion be added that requires developers to prove they will not violate the Environmental Protection Agency's definition of environmental justice. This criterion will require a community participation process through public hearings if any concerns are raised with regards to environmental injustice.*

Act 250 does not contain any criteria or jurisdictional thresholds that require developers to consider environmental justice concerns in Vermont. Specifically, Criterion 8 requires that developments have no undue adverse effect on aesthetics, historical sites, rare or irreplaceable natural areas, however, there is no consideration for "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income" with respect to the implementation of these permits (EPA 2013). Thus, it is important to consider which communities have been disproportionately affected by development projects, polluting industries, toxic waste sites and other environmental hazards in Vermont.

*Environmental Justice: The economics of race, place and pollution*, discusses how “disproportionate siting, discriminatory politics and enforcement, and coming to the nuisance” are all mechanisms for the distribution and concentration of observed environmental inequities in different communities (Banzhaf et al. 2019). Often, low income and minority communities are forced to “live closer to Superfund sites and to large air polluters” and “suffer more from the adverse consequences of such proximity” (Banzhaf et al. 2019). By including an environmental justice criterion, Act 250 will provide a platform for communities to raise concerns regarding environmental injustices in Vermont—specifically related to reviewing site placement during the permitting process.

Act 250 currently only covers around 30 percent of developments in Vermont, however developments with Act 250 permits often have an outsized effect on the surrounding community. For example, the proposed Champlain Parkway in Burlington is a road that will cut through the South End neighborhood (Lamdin 2019). While this project has been reconfigured over the past few decades to appease intense opposition in the city, it is still critical to consider what populations this project will affect moving forward. The Champlain Parkway was granted an Act 250 permit, however, at the time, the Act 250 criteria did not require developers to consider how their project would disproportionately affect low-income or minority communities and community members now question whether the project’s environmental impact statement is up to date (Lamdin 2019).

The construction of this parkway not only highlights the need for an Act 250 environmental justice criterion moving forward, but also the need for an increased awareness surrounding the disproportionate effect of environmental injustices on low-income Vermont communities. Vermont’s cost of living has increased over the past 50 years, thus it is

extremely important that low-income and marginalized communities have clean, safe places to live without threat of disruptive or polluting developments.

By including a criterion that focuses solely on providing the definition of environmental justice, developers will have to prove that they do not violate the terms of the criterion. If concerns are raised that the development will disproportionately affect low-income or minority communities then the developers will be required to work with the community to alter the development plans. The new criterion will require district commissioners to hold community meetings so that community members will be able to voice concerns on the proposed project. Additionally, this criterion will require that developers be a part of these scheduled meeting.

*Recommendation 4: To combat the imminent threat of climate change on the Vermont ecosystem, we recommend that the draft bill of Act 250 include a new criterion that requires specific green building infrastructure.*

Act 250 requires developers to consider if their projects preserve natural resources, conserve energy and reduce environmental degradation; however Act 250's criteria are flexible in how they suggest developers implement green technology and techniques to carry out these goals. Act 250 should introduce a new criterion that requires developers to include renewable energy infrastructure in the building plans if the site allows for it. Furthermore, all developers must include plans for how the development could achieve or transition to zero net energy (ZNE) in the future.

A ZNE building can produce as much energy as it consumes over the course of a year from renewable sources. While ZNE was first adopted to an individual building scale, this system can be modeled for a community, district, and campus level to expand customer

benefits and minimize costs (California Public Utilities Commission 2019). ZNE reduces the need for “new energy infrastructure costs such as the transmission and distribution upgrades, [achieves] high levels of energy efficiency, and support[s] grid reliability by incorporating technologies such as storage and smart inverters” (Blue Point Planning 2018). The adoption of ZNE also works to “provide affordable access to renewable energy generation” while also utilizing smart grid technologies and aligning with “state energy and environmental policy goals at the community level” (Blue Point Planning 2018).

Although transitioning to entirely ZNE system has inherent challenges, states like California have paved the way by aiming for all residential buildings to achieve zero net energy by 2020, and all commercial buildings to achieve ZNE by 2030 (California Public Utilities Commission 2019). While this goal does not have legal standing in California, the California Senate Bill 100 has committed the state to clean energy by requiring “renewable energy and zero-carbon resources to supply 100 percent of electric retail sales to end-use customers by 2045” (California Legislative Information 2018).

Similarly, the state of Vermont has committed to sourcing 90 percent of its energy from renewable sources by 2050 (2016 Vermont Comprehensive Energy Plan 2016). This comprehensive energy plan embraces “a distributed energy future in which a significant portion of Vermont’s energy is produced near where it is consumed, and which is shaped by many coordinated actions by distributed energy users, rather than through singular central control” (Vermont Department of Public Service 2016). Thus, by requiring all developments to include renewable energy infrastructure in their development plans, Act 250 will work jointly with Vermont’s Comprehensive Energy Plan to reach Vermont’s clean energy goal by 2050.



In order to implement ambitious state-wide ZNE goals by the suggested dates, California has embraced a multi-faceted framework to address the challenges of implementing renewable energy technology on a large-scale. State-wide subsidies and incentive programs directed by agencies outside of Act 250 are strongly recommended to allow for an affordable transition to ZNE (California Public Utilities Commission, 2019). Blue Point Planning describes in depth the drivers and steps for implementing a ZNE system in *California in Commercial & District Zero Net Energy Framework*, linked in the appendix. This document provides distinct steps for reaching statewide ZNE, such as an awareness campaign for ZNE, outreach to corporate partners, monitoring energy efficiency performance for buildings, policy guidance and education initiatives for local governments, and district level planning (Blue Point Planning, 2018).

Act 250 has the ability to catalyze ZNE adoption in the state of Vermont by adopting a framework similar to California's ZNE program. To that end, Act 250 will drastically reduce carbon emissions in Vermont and increase reliance on clean energy throughout the state. Ultimately, developments that have adopted a ZNE system through Act 250 will change a historically one-way energy flow as it both "contributes power and responds to grid requests to manage load while reducing costs and infrastructure requirements" (Blue Point Planning 2018).

### III. Appendix (Supplemental research)

*Our appendix focuses on the details of our GIS analysis and the case studies that provided us with strong examples for how specific states and communities in the United States and worldwide have approached climate change, green development, forest fragmentation and environmental justice. The individuals that we interviewed, our community partner Amy Sheldon, and our course work directed us to many of these case studies. While information from our case studies is included in the main portion of the report, additional helpful information can be found in this appendix.*

#### GIS Analysis

Table 1: Percent of Vermont parcels under Act 250 by county.

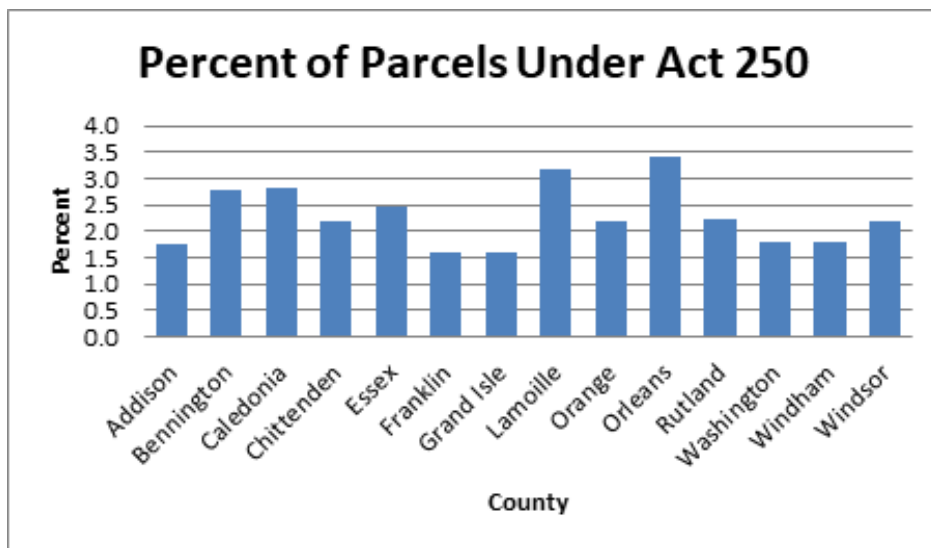


Table 2: Percent of land area 2000-2500 ft under Act 250 by county. Note that Orleans County is the only county with more than 10% of the land in that category currently under Act 250.

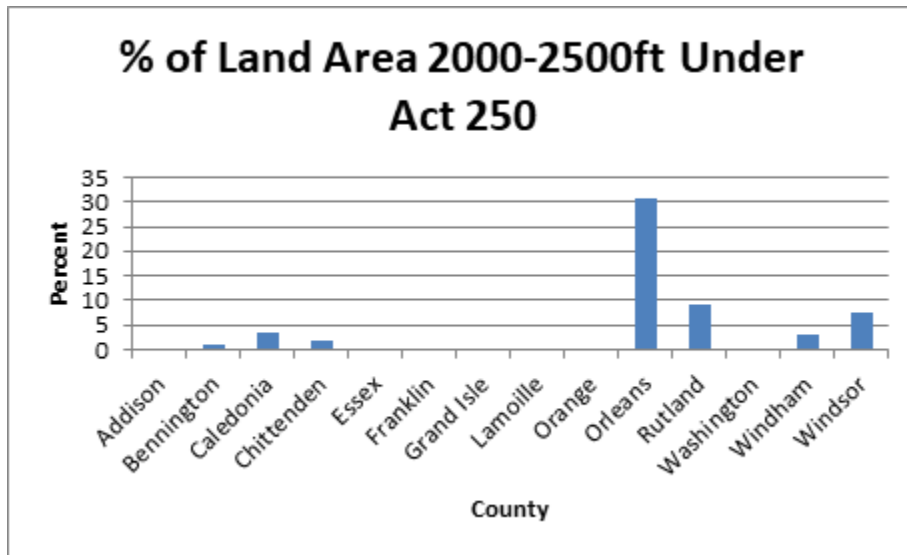
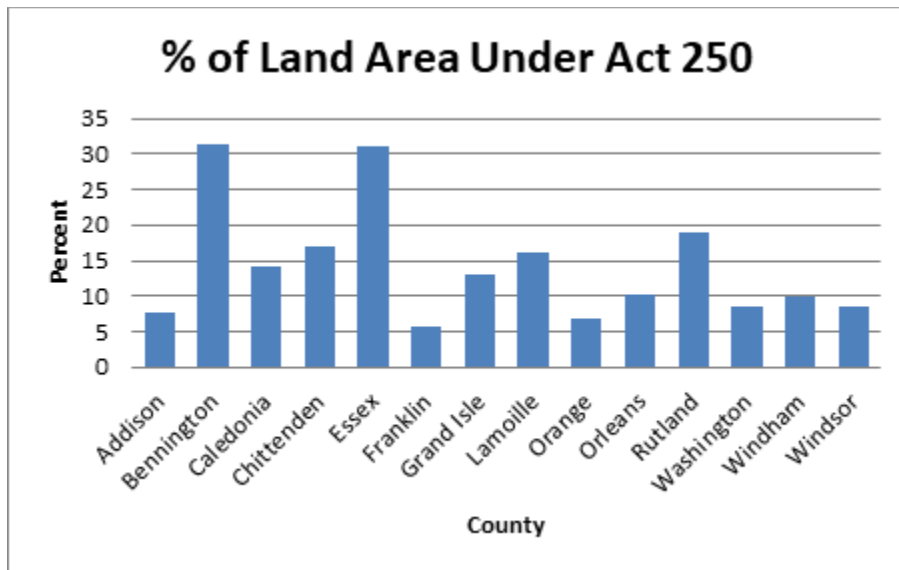
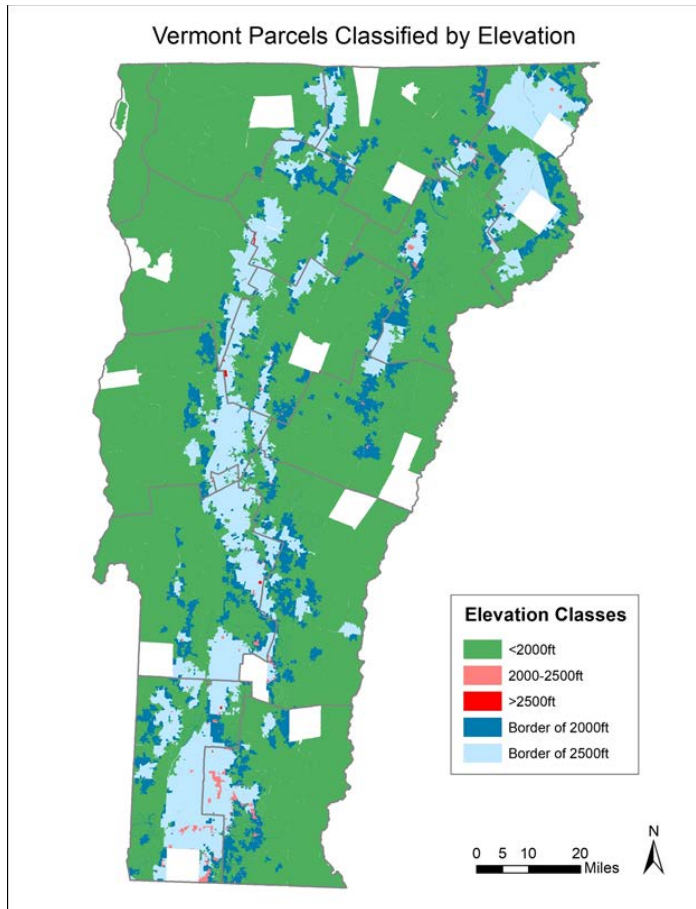


Table 3: Percent of land area under Act 250 by county.





*Figure 5. Vermont parcels classified by elevation. Note that few parcels are located entirely within either the 2000 or 2500 ft elevation contours so it is difficult to determine exactly how much additional land would be covered by lowering the Act 250 elevation threshold.*

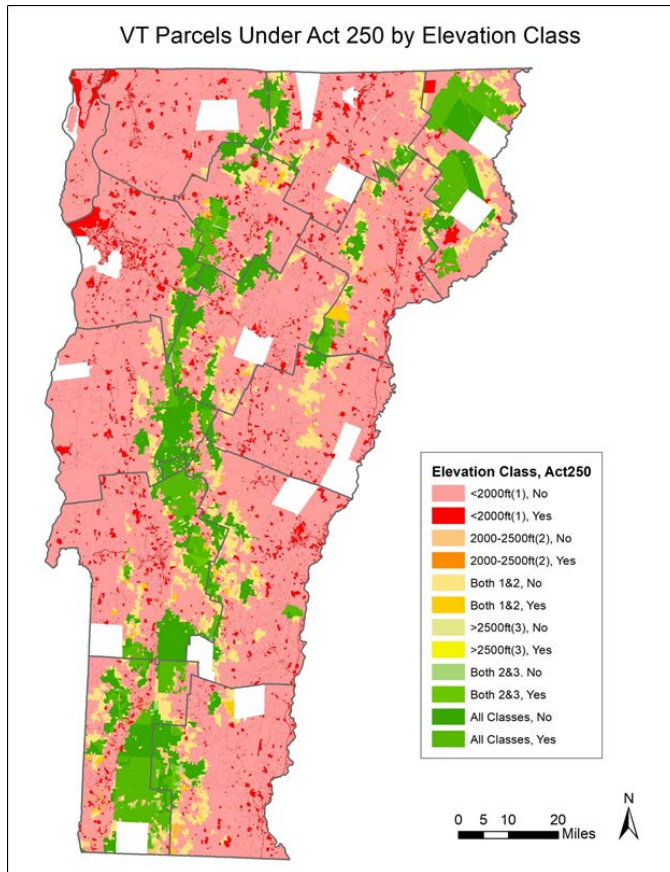


Figure 6. Vermont parcels under Act 250 classified by elevation.

## GIS Methodology

Input Layers (all from VCGI):

- “Act250\_points” [point data]
- “VTparcels” [polygon data]
- “VT\_DEM” [30m pixel elevation raster data]
- “VT\_counties” [polygons of county outlines]

## Vermont Elevation Classes (Fig. 1)

1. RECLASSIFY “VT\_DEM” into three classes:
  - i. 0-2000: 1
  - ii. 2000-2500: 2
  - iii. 2500-max: 3

- b. Output: “VT\_DEM\_reclass” (**Fig. 1**)

### **VT Parcels Under Act 250 (Fig. 2)**

1. In the attribute table of “VT\_parcel”, Add Field called “Act250” (short integer)
2. In “Act250” field, use Field Calculator and enter “Act250” = 0
3. Select by Location “VT\_parcel” intersected by “Act250\_points”
4. In “Act250” field, use Field Calculator and enter “Act250” = 1 [only the parcels intersected by Act 250 points are selected so only they will change to 1]

### **Burlington Parcels with Act 250 Permits (Fig. 3)**

1. Add a World Imagery base map and zoom into Burlington
2. For “VT\_parcel”, set 0 to be blank and 1 to be green and partially transparent

### **Burlington Parcels with Act 250 Permits (Fig. 4)**

1. To add the inset map:
  - a. Add new data frame called “Inset Map”
  - b. Under properties of the main data frame, go to Extent Rectangles and add “Inset Map”
  - c. Zoom out the inset map to match the extent of Fig. 3
2. Yellow circle was added by exporting the map to Adobe Illustrator

### **Vermont Parcels Classified by Elevation (Fig. 5)**

1. RASTER TO POLYGON “VT\_DEM\_reclass”
  - a. Output: “VT\_DEM\_polygon”
2. Export each elevation class polygon into a separate shapefile:
  - a. Outputs: “Under2000”, “2000to2500”, “Over2500”
3. SPATIAL JOIN “Under2000” to “VTparcels”
  - a. Output: “VTparcels\_firstjoin” [in the attribute table, the “gridcode” field is either blank if the parcel is not intersected by the “Under2000” polygon or is “1” if the parcel is intersected by the polygon]
4. SPATIAL JOIN “2000to2500” to “VTparcels\_firstjoin”

- a. Output: “VTparcels\_secondjoin” [in the attribute table, the “gridcode1” field is either blank if the parcel is not intersected by the “2000to2500” polygon or is “2” if the parcel is intersected by the polygon]
5. SPATIAL JOIN “Over2500” to “VTparcels\_thirdjoin”
  - a. Output: “VTparcels\_firstjoin” [in the attribute table, the “gridcode2” field is either blank if the parcel is not intersected by the “Over2000” polygon or is “3” if the parcel is intersected by the polygon]
6. In the attribute table of “VTparcels\_thirdjoin”, go to Select by Attributes, select all parcels where “gridcode1” >0, then go into field calculator and enter “gridcode1 = 10”
7. Repeat step 6 for “gridcode2” and change the values to 100
8. In the attribute table of “VTparcels\_thirdjoin”, use Add Field to create a new field called “ElevCode” (long integer)
9. In “ElevCode”, go to Field Calculator and enter “gridcode + gridcode1 + gridcode2” [the result is that every parcel is classified into elevation classes:
  - a. 1 = <2000ft
  - b. 10 = 2000-2500ft
  - c. 11 = border between 2000 and 2500ft
  - d. 100 = >2500ft
  - e. 110 = border between 2000-2500 and >2500ft
  - f. 111 = borders all classes]

### **VT Parcels Under Act 250 by Elevation Class (Fig. 6)**

1. Using the “ElevCode” and “Act250” fields in the “VTparcels” attribute table, create the 12 different classes in Symbolology

### **Linking County Names to Each Parcel (used for all of the tables)**

1. SPATIAL JOIN “VTcounties” to “VTparcels” using the “have their centroid in” joining option [county lines do not line up exactly with parcel boundaries so if you just use “intersect”, some parcels will only be assigned to counties that a sliver of their land area is in. Using the centroid method almost always ensures that the parcel will be assigned to the county that the majority of its land area is in]

## Removing Duplicate Parcels

1. Some parcels with multiple owners will have multiple overlapping polygons. In order to calculate the land area of a county or of a state, these duplicate polygons need to be deleted. Use DELETE IDENTICAL on “VTparcels” with the field “ShapeArea” selected. I’m not sure if this would work for this dataset but if the FID code for the duplicate parcels is the same then you could DISSOLVE on that field.

## Case Studies:

### *Wildlife Corridors*

- **The Staying Connected Initiative (SCI)** partners with government agencies, universities, and nonprofits to enhance landscape connectivity across the Northern Appalachian and Arcadian regions of the United States and Canada. SCI has nine priority linkages, between critical forest blocks, where they want to ensure the protection of significant parcels that contribute to habitat connectivity, including working forests, forest pathways and river corridors ([pdf on website](#)).
- **New Mexico’s Wildlife Corridors Act** made New Mexico the first state to adopt a comprehensive program to identify wildlife corridors and address barriers to wildlife movement. The act directs New Mexico Department of Game and Fish and their Department of Transportation to develop a joint Wildlife Corridors Action Plan with private landowners, tribes and local communities.
- **Oregon’s Wildlife Corridors Bill** maps the state’s major wildlife corridors and creates a plan to protect them. In addition to large mammals, it also protects smaller species, which are often overlooked. The purpose of this bill is to maintain wildlife connectivity, which is a key component to address the loss of biodiversity from fragmentation. Oregon has some of the highest rate of vehicle wildlife collisions.
- **Beginning with Habitat** is a collaborative program of federal, state and local agencies and non-governmental organizations in Maine, whose goal is to conserve plant and wildlife habitat. Legislation requires an analysis, inventory, comprehensive plan, and implementation strategy on the defined critical natural resources.
- **Maryland State Wildlife Action Plan** discusses how the Maryland Department of Natural Resources needs to outline areas that must be improved to best protect Maryland’s wildlife. Separately, Maryland has a resource conservation plan and corresponding conservation management program that private landowners can follow ([MD DNR](#)).



### *Carbon Offset Program*

- **Oregon's** Department of Forestry created a **Forest Resource Trust**, which administers carbon offset funding (Vermont Forest Carbon Sequestration Working Group).
- **Michigan's Working Forest Carbon Offset Program**, ended in 2011 concurrently with the Chicago Climate Exchange (Vermont Forest Carbon Sequestration Working Group).
- The **Michigan DNR Forest Stewardship Program** did cost share for forest management plans and provided outreach and education to foresters about generating carbon offsets (Vermont Forest Carbon Sequestration Working Group).
- The Georgia Forestry Commission operated the **Georgia Carbon Sequestration Registry**, but saw very low participation (Vermont Forest Carbon Sequestration Working Group).
- The **Oklahoma Carbon Sequestration Enhancement Act** in 2001 made Oklahoma the first US state with the authority to verify & certify carbon offset. A concurrent OFS Forest Stewardship Program provided stewardship plans to landowners at no cost. Five forestland owners participated and generated carbon offsets (Vermont Forest Carbon Sequestration Working Group).
- **The Spatial Informatics Group (SIG)** works with carbon project partners to identify key attributes and datasets that can be used to identify parcels statewide that might be suitable for both development of a forest carbon offset project and to help protect and enhance key co-benefits. Interior forest blocks provide notable co-benefits, and were identified in the Vermont Conservation Design project (Keeton et al.).
- The Pinchot Institute is piloting the **Forest Health-Human Health (FHHH) Initiative** to demonstrate how voluntary carbon markets can provide a funding mechanism to help families maintain their private forestlands ([American Carbon Registry](#)). The FHHH Initiative provides family forest owners with the option to implement sustainable forest management practices to store additional carbon in their forests, thus presenting them with an alternative to developing or selling forestland.

### *Green Development*

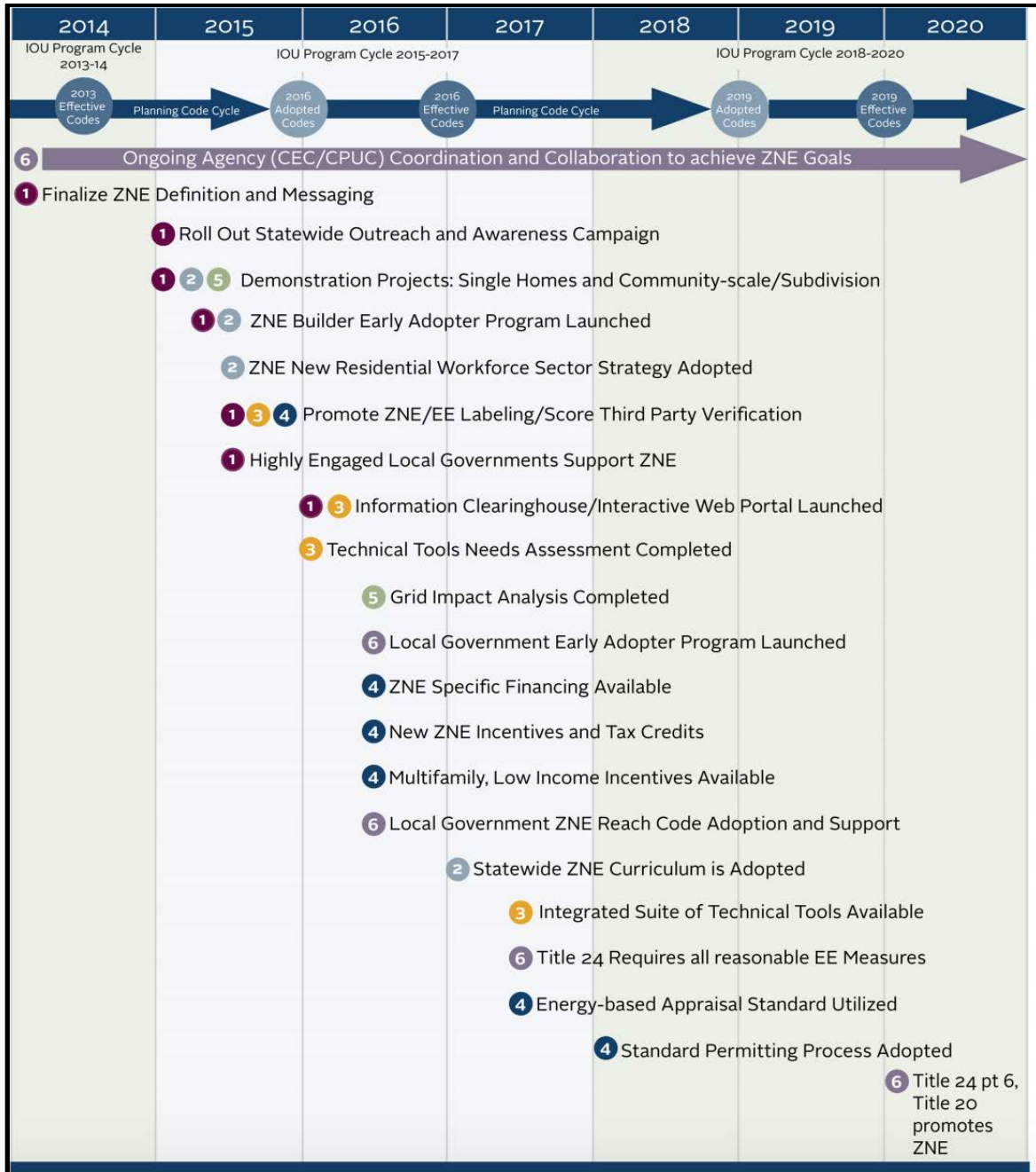
- **Blue Point Planning Net Zero Energy Frameworks:** [Commercial Net Zero Framework](#) and [Residential Net Zero Framework](#).
- **Shanghai's Changning District** government piloted bold policies and incentives for energy efficiency which at the time had not been replicated on a national level in China. Through this retrofitting process, the Changning government implemented an online energy monitoring platform that tracks 160 of the district's 165 public buildings. To monitor the building's energy efficiency, the government uses an online platform that tracks energy usage. This platform works to "assess, manage, monitor and verify energy

performance and efficiency opportunities” which, in turn, optimizes the system operations and verifies renewable energy measures in place (World Bank 2019).

“ Technologies would span lighting, heating, ventilation, and air conditioning (HVAC), insulation, envelope, and energy management systems. The ‘pilot’ character of schemes for building EE would come from innovative policies to benchmark performance and mandate retrofit of inefficient buildings, business models to bundle many small projects, and a risk guarantee mechanism to facilitate financing. Data to inform the design and implementation of such policies and mechanisms would be provided by audits and feasibility studies but moreover by advancement in functions of an online monitoring platform. Support for a new near-zero emission (NZE) building would demonstrate its technical and commercial feasibility and drive down costs through the technology learning curve.” (World Bank 2019)

- **Regenerative design** is a movement that critically questions how the built environment can have a net positive impact on the surrounding ecosystem. The Centre for Interactive Research and Development at the University of British Columbia in Canada describes how focusing on site design, energy, water, resource conservation, occupant health, and building operation and maintenance all support regenerative design principles. Specifically, this centre has outlined key guiding principles for creating regenerative buildings:
  1. Design with time in mind— anticipate climate change, design for a 100-year life cycle, build to last but allow for change.
  2. Materials should be selected based on zero waste criteria—design for modification and disassembly, do not use toxic materials. Convert ongoing ‘waste’ streams to useful flows.
  3. Energy use should have a net positive impact on ecological health— minimize onsite consumption, use renewable energy sources, or harness waste heat from adjacent buildings, or displace energy that was being used by adjacent buildings.
  4. Water use should have a net positive impact on ecological health; achieve self-sufficiency on the water flows available to the site.
  5. Site design should produce a net positive impact on ecological health— create additional habitats compared to existing site value.
  6. Provide instrumentation and controls to allow feedback and learning.
  7. Produce a core building that exemplifies best practice, economical solutions.

8. Provide a comfortable, healthy environment for inhabitants, including 100 percent natural daylight spaces, and temperature and ventilation under local or individual control.
9. On an ongoing basis, assess the interaction between the environment provided by the building and the health, productivity, and happiness of those who work and visit it.



California Zero Net Energy: This chart visualizes both the framework and guiding principles for implementing ZNE on a state-wide scale.

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